THE DAILY AND SEASONAL ACTIVITY OF A HIVE OF BEES.

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NOT long ago there was performed a series of experiments with a hive of bees by a French bee keeper, M. Leon Dufour, and published in one of the French apicultural journals, which is of considerable biological interest, showing, as it does, the relation of the activities of bees to the various conditions of honey flow, number of bees, season, etc. Although hives have been frequently weighed to show the daily increment of honey, this was the first attempt to find out what more might be learned by weighing. An hourly record of the weight of the hive used in the experiments was kept each day through the whole season. From the data obtained it was possible to plot daily and seasonal curves, some of which are here reproduced. Although the most was not made of the facts learned in making comparisons, enough was done to bring out the relations between the activity of the bees and the flow of nectar during the day, and the season, as well as the relation between the daily amount of nectar collected and the number of bees in the hive, and between the number of bees and the different seasons. The series of hourly weights also shows the rate at which the bees leave the hive, and when the number returning exceeds those departing. The facts learned by the experimenter might be carried further and comparisons made with hourly, daily, or seasonal changes of weather, and with the floral calendar of any particular locality, and it is with the hope that further experiments may be performed and carried out with greater detail that the account of Dufour's experiments is given here.

In these experiments the first morning weight was taken as the zero point for the day. As is evident in the curves reproduced in the figures, this weight was made sometimes at 5 A.M. and sometimes at 5.30, and sometimes later. The general

results, however, remain essentially the same. On May 8 this weight was taken at 5 A.M., and, as shown by the curve (Fig. 1), the weight of the hive slightly decreased during the next hour, or, in other words, the bees left it for their field labors in small numbers, but at 6 o'clock large numbers of the bees left, for during the succeeding hour the weight of the hive decreased by about 300 gm. From 7 o'clock until 8 the number of outgoing bees seemed to decrease, for the line of descent, as shown in the figure, is not quite so precipitous. This change, however, might and probably was due to returning bees. This brings out the crudity of the method of experimentation; for the curves, without an actual counting of bees, can show only relative numbers. This, however, is sufficient for practical purposes. At 8 o'clock the hive was over 500 gm. lighter than in the morning, and from this time until 9 it decreased in weight but little, reaching then the minimum forenoon weight of— 550 gm. From 9 o'clock until 10 the hive very slowly increased in weight, and then more rapidly, until at the end of the next hour the weight had risen to 380 gm. below the zero weight. Then it as rapidly decreased until noon, after which it slowly sank to 620 gm. below the morning weight,—the second minimum and

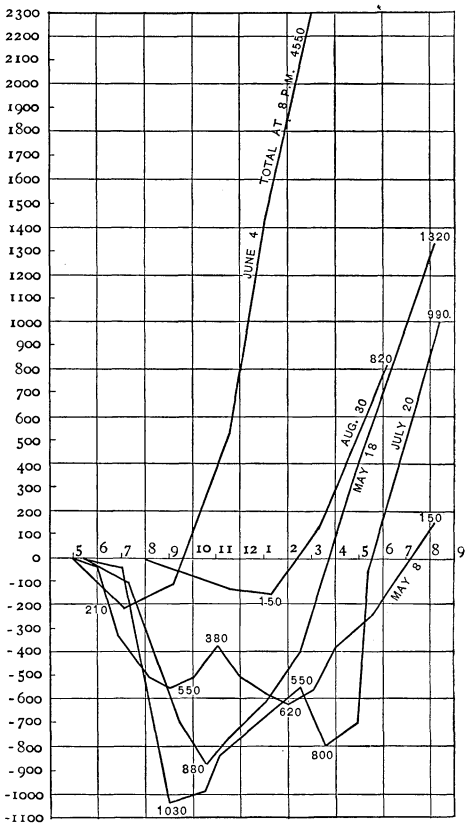

FIG. 1. — The horizontal lines show the weights in grams above and below the zero line (= the first morning weight). The vertical lines represent time.

the lowest for the day. From this time on the bees returned in large numbers evidently, and the hive consequently rose in weight, so that it passed the zero line at 7 o'clock, and reached 150 gm. above the morning weight one hour later, when the weighing was discontinued. This 150 gm. of course represents the amount of stores secured during the day.

The most remarkable feature of this curve is the sharp rise just before noon, thus making two points of minimum weight for the day. Several suggestions might be made to explain this peculiarity. Directly, it is certainly due to a large number of bees returning at about the same time. The small amount of honey gathered and stored during the day seems to indicate some relation with the nectar flow, which evidently was not great. Dufour, basing his remarks on experiments by Bonnier, explains the matter by pointing out that the flow of nectar varies during the day, and has a forenoon and an afternoon maximum flow, with an intervening period of small flow. According to these experiments, the nectar flows freely during the cooler portions of the day and much less so during the period of greatest heat, which ordinarily comes somewhat after midday. Of this change in the nectar flow the bees take advantage, and the peculiar curve which has been described is a result. This explanation is not, however, sufficient to account for the rise in this particular curve at 11 o'clock, for the reason that, as noted above, the hottest part of the day does not ordinarily occur in the forenoon. It seems, however, to explain the curve of July 20, where the intermediate rise reaches its maximum at 2.30. The difference between the two curves in respect to this rise may doubtless be explained by the difference in the total flow of nectar, which a comparison of the two curves shows to have been very much greater on July 20. The flow being small on May 8, it would consequently soon be exhausted, causing the bees to return earlier than they would have done had it been more abundant.

By May 18 conditions had evidently very materially changed. During the first one and one-half hours the bees left the hive slowly, although somewhat more rapidly than during the corresponding time on May 8. From a little after 7 o'clock they left

in large numbers, so that the weight of the hive sank rapidly to 880 gm. below the morning weight. From this time (10.30) the weight of the hive rose with almost as great rapidity as it had decreased, and passed the zero mark a little before 4 o'clock. It continued to rise until 8 P.M., when the record shows that 1320 gm. of stores had been added during the day.

The striking feature of this curve is the absence of the intermediate rise forming so strong a feature in the curve of May 8. But the difference seems explainable by the greater flow of nectar, evidently close at hand, which enabled the bees to quickly secure and return with their loads. The short flow of the middle of the day must certainly have been relatively very much more abundant than the aggregate power of the small laborers to dispose of it.

In the other curves there is shown some slowness in starting to work in the morning. On June 4 (Fig. 1) the decrease in weight was comparatively rapid and continued at the same rate at which it began. At 7 o'clock, or two hours from the first weight, the hive began to increase somewhat slowly in weight until a little past 9. Then it increased rapidly and crossed the zero line about half an hour later. By 8 P.M. 4550 gm. had been added to the morning weight of the hive.

The curve for July 20 is remarkable for the great decrease in weight, 1030 gm., and for the rapidity of the decrease, reaching, as it did, the limit at 9 A.M. Unlike the first minimum of May 8, this is the lowest of the two for the day. The reason for the difference is doubtless to be found in the greater flow of nectar on the latter day, as shown by the 990 gm. of stores added for the day. Finally, the very precipitous rise in weight, from about 700 gm. at 5 to about 60 below the morning weight, during the next 20 minutes seems somewhat remarkable.

If, now, the amount of stores be poor, it is evident that the different periods of strong honey flow for the season may be contrasted readily with the seasons of poor honey flow and with the blooming time of different species of nectar-bearing plants. In connection with what Dufour tells his readers, the curves here reproduced show two periods of good honey flow and two of poor honey flow. The first of the latter periods

began the season. It was followed by a period of good honey flow, extending from the latter part of May through June, and was due mostly to the blooming of acacias, which were evidently close at hand. The greater part of the summer was occupied by the second of the two periods of relatively poor honey flow, and was succeeded by the second of the other periods, beginning in the latter part of August and continuing into September. This, Dufour informs us, was mostly due to heather bloom.

A further comparison is to be made which brings out the relation of the number of bees in the hive to the different portions of the season. To make this comparison somewhat more accurate, curves are chosen (Fig. 2) that show almost the same amount of added stores for the day. On May 11 the workers were evidently numerous, since the hive decreased in weight by 730 gm., and if 10 bees be allowed to a gram there must have been more than 7300 bees at work. By July 18 they had increased greatly, so that, as shown by the minimum weight of 1510 gm. for the day, there were evidently more than 15,100 workers that left the hive, which is more than twice as many as on May 11. In August, as shown by the curve for August 21 and that for August 30 (Fig. 1), there were very few bees — on the former date only about 2000 that went to work. At first glance the curve for June 4 seems to show the same dearth of workers, but on May 18 they were relatively numerous, and, since it is scarcely possible that the workers had died off in great numbers between the two dates, the

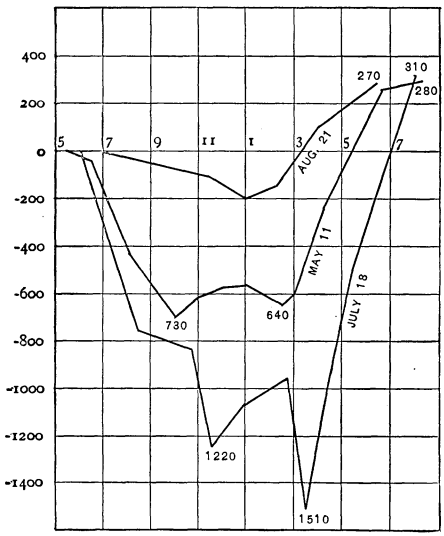

FIG. 2. — These curves are compared to show the differences in the number of bees in the hive.

small decrease in weight on June 4 seems to be more correctly attributed to the fact that the bees secured their stores so near by and returned so frequently and in such numbers that a very small (210 gm.) instead of a great decrease in weight resulted. The same explanation, also, may account for the curve crossing the zero line during the forenoon.

From the data that have been given one may conclude

1. That for the particular locality, Fontainebleau, where the weights were taken, there are four periods of honey flow, two characterized by an abundant and two by a poor flow, and that the activity of the bees through the abundant flow and that during the poor flow is characteristic in each case. During the poor flow there is a period of comparative inactivity during the middle of the day, corresponding apparently to a period of small flow of nectar, but during the abundant flow the activity of the bees is more or less constant through the whole day.

2. Aside from this midday activity the bees go and come steadily, and the hive, after the minimum weight is passed, increases in weight progressively and with comparative steadiness.

3. When the flow of nectar is poor, or comparatively so, the bees during the first hour or so leave the hive slowly. At the end of this time the rate of departure changes to a very rapid one, which continues with slight variation until the minimum weight is reached.

4. When the flow of nectar is abundant the rate of departure continues, as at the start, to be practically the same until the minimum is reached ; but this feature of the curve may be due also to the greater number of bees returning to the hive and the unloading of heavy loads more than to the bees maintaining a constant rate of departure.

5. When the flow is very abundant the outgoing bees do not reduce the weight of the hive to so great an extent as when the flow is relatively poor.